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POPULAR AND PRACTICAL ENTOMOLOGY

METHOD OF PROCEDURE IN INSECT LIFE HISTORY INVESTIGATIONS.

BY WM. P. HAYES,

Assistant Entomologist, Kansas Agricultural Experiment Station*.

It is hardly necessary to emphasize the importance of life history investigations as an aid to the control of injurious insects. To the economic entomologist is allotted the development of methods of suppression, and without some knowledge of the life history of the insect in question, his efforts to control may be futile. It is, therefore, clearly obvious that the first effort in attacking the problem of insect control must be the acquisition of an understanding of the insect's life history.

The writer as a novice in entomology, about seven years ago, was assigned to Southern Kansas and placed in charge of a field laboratory established for the purpose of working out the life histories of two serious insect pests of that part of the state. At the time a prepared schedule was furnished for the methodic study of insect life histories. Since then the value of such a schedule has been more fully realized. Investigators are far too frequently found who do not realize how much they know about a given subject or animal until they have subjected themselves to the processes of orderly arrangement when the results obtained are found to be surprising and satisfactory. Often there has been no attempt to classify data which are obtained by a poor method of approach. Their knowledge is merely a mass of scrambled observations which, if untangled, may lead to many unconsidered possibilities, and in recording their facts they are apt to omit many important matters which are overlooked in a forest of tangled ideas. They do justice neither to themselves nor their readers. They may have many times the number of facts which they record and the reason they are not recorded is the lack of systematic arrangement. Far too many life history papers exhibit this defect. Undoubtedly a partial solution of, or at least an improvement in the character of life history investigations, lies in the possession and use of an orderly plan, as is here suggested.

The first and most important starting point is an accurate determination by a specialist, if necessary, of the species under consideration. Its correct scientific and all common names should be known, and a complete bibliography should be made up. Special literature should be secured and copies of state and national laws affecting entomology should be available, especially those pertaining to quarantine regulations if the species may in any way be involved in legal entanglements.

After the bibliography has been prepared, the investigator has learned

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what is known about the insect. Adequate laboratory facilities should then be available and a system of record keeping established. This should include besides observations on the animal, statistical, climatological, geological, and miscellaneous data that may have a bearing on the species in question.

The first steps in such a study will depend to a large extent on the time of year in which the work is begun and the corresponding stage of the insect's development. That is, if work is begun in the spring and the insect is in the adult stage, the first observations will be on the mature form. However, a logical treatment should begin with the egg and the study develop as the insect proceeds through its various stages of metamorphosis. In the egg stage there are at least four important points to be noted; first, an adequate description of the egg which will permit of it being recognized by others; second, the embryology or development of the egg. This point is important and a great amount of data can be amassed on the one subject. Nelson's "Embryology of the Honey Bee" is an example of the vast amount of material that can be assembled on the development of an insect egg. The third point is the duration of the egg stage which should be known under different climatological conditions which affect the length of time required for development. Large series should be studied in order to obtain averages with a minimal probable error. Lastly, the method of hatching should be carefully investigated. This is often a weak and critical stage in the insect's life and important control measures might suggest themselves at this time. More will be said concerning oviposition habits of the adult insect.

The next stage is either the larval or nymphal, depending on the kind of metamorphosis, and here a good description is desired and the anatomy both external and internal should be worked out. The rate of growth and number of moults are important. It is surprising how little is known of the method of moulting and the frequency of its occurrence in many of our common species.

The process of moulting may be variable and the food supply may have a decided influence on the time of moulting. The size of the insect in each instar may have an important significance. Davis, of Indiana, is now working on the size of the various instars of white grubs and can identify species by their size, and Dyar has devised a system of proportions whereby the various sizes of caterpillars can be computed if the size of one instar is known. The duration of the complete stage varies and in many larvae a prepupal condition is assumed. This again is a critical stage where effective control measures may be applicable if the species is destructive. Before pupation, pupal cells are often constructed, a knowledge of the method and the locality where they are built being desirable. Habits of feeding and methods of securing protection are important, and the character and degree of injury are vital points. The rearing of large numbers over a series of years is desired to obtain the foregoing points under various conditions.

The pupal notes likewise involve a description that is complete and a knowledge of the anatomy is necessary. Important post-embryonic changes are occurring within the pupa and much work has been done on this subject which is known as histogenesis. The length of the pupal stage varies from a

few days to many months, or even years. The Hessian fly has recently been noted as living over four years in the papurium, which fact has an important influence on the control of the species. The transformation from the pupa to the imago is an important phase in the insect's life economy.

Now the adult must be considered. Again a description should be given and thorough morphological and physiological studies made. The period from transformation to complete maturity differs in some forms. In ants there is an interpolated stage known as the callow, and in May flies a sub-imago stage. Color changes and other points can here be noted. The size of the insect may have a relation to the amount of food supply and this in turn may influence the duration of adult life. Weights and especially dimensions are useful in making taxonomic determinations. An average length of life should be computed under both natural and artificial conditions. Various foods may influence the duration and tests can be made with food and without water, also without food and with water.

Ability to distinguish the sexes is necessary and with some species this is hard to do superficially. The secondary sexual characters are used in this connection, and when lacking one must resort to the primary characters. The relation of size and color to sex is a point to note and the proportion of sexes has an important bearing. In Lachnosterna, the males predominate at lights during the spring flight, while a larger number of females are found on the food plants. With different insects, the proportion may vary at different seasons, so they should be observed for these data in the spring, summer, and fall, as well as during hibernation. Likewise, the sexes may vary during flights and under the influence of temperature conditions.

The number of generations may vary in a season, and the maximum, minimum, and average number of broods are important considerations. These again are determined by environmental conditions. The duration of the complete life cycle with its minimum, maximum, and average broods can then be summed up. With a tentative knowledge of the life cycle now at hand, the investigator is in a position to make a more thorough study of the life economy of the insect which involves consideration of the ecological features. To enumerate these would require too much time. However, a few of the following points should not go amiss. Habits of the species are ecologically important and require a knowledge of food plants, of what part, such as leaf, fruit, bud or root, is attacked, the susceptibility of different varieties of food plants, tests with other food plants and the occurrence on other than food plants; or, if parasitic, a knowledge of the hosts, prey and feeding habits of larva and adult. Temperature has its influence on feeding activity and may be the factor causing either nocturnal or diurnal feeding periods. Cannibalism as practised by some insects has a bearing on the method of rearing some species which must be kept separate in laboratory cages. The same is true of those with predaceous habits in either the larval or adult stage. The food plant investigations may suggest trap crops or other measures of control, such as clean culture.

Reproduction in insects is tremendous at times, and a knowledge of the processes of fertilization, polygamy, polyandry, and parthenogenesis are highly

important. The places of oviposition, the formation of the egg cavity, time required to deposit the egg, number of eggs deposited, dependence of oviposition on food supply, and the effect of oviposition on the plant, require careful observations and well-kept notes. These activities should be observed in the laboratory and field and differences noted. Other factors involved and perhaps influenced by the environment are the periods of first, last and maximum oviposition, as well as the rate or number of eggs laid daily.

Protection by mimicry is an ecological factor about which much can be written. Other methods of protection are found at all stages of various insects. The eggs may be protected by being deposited internally, by isolation, external structure, or protective secretions; larvæ and adults by places in which they develop, by external structures, such as spines, repellent odors, protective constructions (caddis flies) and protective excretions. Habit sometimes offers protection, and we find strong fliers, swift runners and active swimmers. Coloration involves mimicry and warning coloration, both of which afford protection. The pupa, to shield itself, may hide, construct cocoons and earthen cells, roll leaves, form galls, or be protectively colored. All these are important in life history investigations.

Theoretically, the annual progeny of a single pair should be computed and the number of individuals per acre should be estimated on a basis of field counts. The rate of multiplication is directly influenced by the available food supply which places restrictions on the numbers present.

Seasonal history is important and such factors as hibernation and æstivation must be considered. The time of entrance into hibernation is affected by temperature which in some species determines whether entrance shall be gradual or sudden. Different species have different stages passing the winter. The individuals may be congregated or found singly and this may be a factor affecting mortality at the time of entering hibernation. There is also mortality during and at the time of emergence from hibernation. The time of emergence from hibernation, like the period of entrance, is influenced by climate conditions and it may be abrupt or gradual. Sometimes re-hibernation occurs. The number and percentages of individuals entering and surviving hibernation ought to be observed. The finding of food in the spring is an important problem for the individual and one can determine the nature of the first food supply, the preferred food, how far they will go for it, and the duration of life of hibernating individuals. All these factors influence the relative abundance of the species and the amount of damage they are capable of doing in the spring. The abundance of pests that did so much damage in Kansas during the spring of 1921 can be traced to the mildness of the preceding winter which caused little mortality in hibernation.

The progress of infestation during the season should be followed and such points as the time and effect of the maximum infestation and percentage of the crop destroyed should be noted. Nothing has so far been said of parasites, predaceous enemies, and fungous diseases. These should all be studied.

The following list will serve to show the number of points of attack that may be studied to work out control measures; under natural control we have cannibalism, adverse climatic conditions, fungous and bacterial diseases, parasites, and predatory enemies; and, under artificial control, traps (trap crops, lights, shelters, and trap rows), insecticides, repellents, certain types of farm machinery, restriction of spreading by quarantine, disinfection and fumigation, and cultural methods of control.

Another desired feature is experimental farm work involving a sufficient knowledge of farming methods to conduct time of planting tests, variety, fertilization, cultivation, soil and isolation tests as applied to insect control. Obviously, the investigator should have a broad fundamental training and his time and available funds should be guarded against wasted energy.

A PARTHENOGENETIC MAYFLY (*AMELETUS LUDENS* NEEDHAM).

BY WILBERT A. CLEMENS,

Department of Biology, University of Toronto.

The female subimago and nymph of *Ameletus ludens* was described by Needham (1905) from material taken at Newport, N.Y. The nymph of this mayfly is a small brook-inhabiting form which occurs very abundantly in the many small brooks in the vicinity of Ithaca, N.Y. At the season of emergence the female subimagoes and imagoes are not uncommon along the banks of these brooks. A suggestion that reproduction in *Ameletus ludens* might be a case of parthenogenesis was made by Morgan (1911) who recorded unsuccessful efforts to find the male of the species in spite of extended and diligent search. In order to test out this suggestion the writer had this species under more or less constant observation from June 14, 1913, to July 30, 1915.

From June 14 to June 30, 1913, only a few mature nymphs were found in the brooks and no adults were observed. Apparently the period of emergence was practically over since in early July no nymphs could be located. By the middle of August the brooks had ceased to flow, there being only an occasional stagnant pool or some slight dampness and stretches where no trace of moisture was evident.

On April 18, 1914, almost mature nymphs were abundant and on April 27 a male subimago was discovered resting on the surface of the water having just emerged. A short distance away a female subimago was also located. These were both taken to the laboratory and placed in wire cages but unfortunately the male failed to transform. No other male has been found although much time has been spent along the streams in search, hundreds of nymphs have been examined and many subimagoes reared. Females were fairly abundant during this year up to the middle of June and mature nymphs could be found up to about June 30 as in the preceding year. Again the streams were practically dry during midsummer.

On May 6, and again on May 8, 1914, eggs were dissected from reared females, placed in water in petrie dishes and kept in the laboratory. The water in the dishes was changed usually every other day. Fertilization could not have occured by any chance since all the nymphs were examined before being placed in the rearing cages. (The sexes can be distinguished in mature mayfly nymphs by the size of the eyes and by the rudimentary genitalia). All the subimagoes which emerged were females and these were transferred to wire cages. The adults used in this experiment were dissected about 24 hours after the subimaginal moult. On October 5 a newly hatched nymph was found in one of the petrie dishes and examination of the eggs showed moving embryos. Hatching continued for over a week. The period of incubation was thus almost exactly 5 months. No record of the temperature changes in the laboratory was kept during this time except that on September 1 and 2 the air temperature was 28.3 C. and again on September 11 it was 15.5 C.

Fertilized eggs of other species of mayflies were kept during this summer at the fish hatchery in Cascadilla gorge where the air temperature was considerably lower and these hatched as follows: *Hexagenia bilineata* 29-40 days; *Hexagenia recurvata* 14 days; *Ephemera varia* 15 days; *Heptagenia tripunctata* 11-23 days; *Ecdyurus maculipennis* 12 days.

The long period of incubation in the case of *Ameletus ludens* may be a characteristic which has made possible the existence of this species in brooks which are subject to mid-summer droughts. The presence of a thickened roughened coat on the egg would appear to support this belief. The egg is figured by Morgan (1913).

The seasonal history for 1915 was much the same as in the two previous years. Nymphs 4 to 7 mm. were abundant in January. Mature nymphs were present in large numbers toward the end of April. On April 27 many emergings took place and one female was observed ovipositing at 8.30 a.m. By June 7 only a few nymphs remained in the brooks and no adults were observed.

These results show conclusively that *Ameletus ludens* reproduces parthenogenetically. The finding of the single male indicates that the evolution toward complete parthenogenesis is not yet complete and that sexual reproduction probably occurs in very rare instances. Whether or not this parthenogenetic condition of *Ameletus ludens* is of local or general occurrence cannot be said at the present time.

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ANNOTATED LIST OF THE BUPRESTIDAE OF PENNSYLVANIA (COLEOPTERA).

BY JOSEF N. KNULL,

Bureau of Plant Industry, Harrisburg, Pa.

In the preparation of this list of *Buprestidae*, which is arranged according to Leng's Catalogue*, a number of original rearing and collecting records and observations have been utilized, to which have been added records from several private and museum collections, and likewise those in the Pennsylvania State Collection. Various records in literature on this group, pertaining to Pennsylvania and adjacent states, have been included, since there is a strong possibility that several species recorded from nearby states occur here.

The work was carried on under the direction of Prof. J. G. Sanders, Director of the Bureau of Plant Industry. The author is also indebted to Dr. Henry Skinner and E. T. Cresson Jr. for the privilege of studying the Horn Collection in the Academy of Natural Sciences of Philadelphia, and to the following persons for valuable records and suggestions: Messrs. H. E. Burke, A. B. Champlain, E. M. Craighead, C. A. Frost, H. B. Kirk, H. G. Klages, F. R. Mason, A. S. Nicolay, H. B. Weiss and H. W. Wenzel.

Polycesta Sol.

P. angulosa Duv. (*obtusa* Lec.) Near Philadelphia (LeConte). A southern species which was probably imported in southern lumber.

Recorded as breeding on *Coccolobis laurifolia* in Florida.

Acmaeodera Esch.

A. ornata Fab. Mount Holly, June 22 (V. A. E. Daecke); Carlisle Junction, April 27 (A. B. Champlain); Darby (H. W. Wenzel).

A. pulchella Hbst. S. W. Penna. (Dr. Hamilton); Erie, July (H. G. Klages).

A. tubulus Fab. Common on flowers throughout the state in May and June. Recorded as breeding in hickory and white oak (*Quercus alba*). A. B. Champlain reared an adult from dead redbud (*Cercis canadensis*) collected at Rockville.

Ptosima Sol.

P. gibbicollis Say. Common where redbud (*Cercis canadensis*) occurs, in which tree the species breeds. The adults mature in the fall and pass the winter in their pupal cells.

Chalcophora Sol.

C. virginiensis Drury. Common throughout the pine section of the state, breeding in partly decayed stumps and trunks of both hard and soft pines.

C. fortis Lec. S. W. Penna. (Dr. Hamilton); Morris, June 20 (I. H. White); Endeavor, July 30 (Kirk and Knull); Charter Oak, June 18 (Author). Reared from dead white pine (*Pinus strobus*). Collected at Charter Oak.

C. liberta Germ. A common species which breeds in dead pine.

Chalcophorella Kerr.

C. campestris Say. A common species which has been recorded as

*Catalogue of the Coleoptera of North America, 1920.

breeding in dead sycamore (*Platanus occidentalis*), beech (*Fagus americana*), and willow (*Salix nigra*). The adults overwinter in their pupal cells.

Dicerca Esch.

D. divaricata Say. A common species, which breeds in the heartwood of a great variety of dead trees.

D. caudata Lec. North East, Aug. 8, Charter Oak, June 5 (E. M. Craighead); Harrisburg, Aug. 11 (H. B. Kirk); Cresco, June 9 (Author). Recorded in the literature as breeding in birch (*Betula nigra*).

D. prolongata Lec. S. W. Penna. (Dr. Hamilton); North East, June 9 (E. M. Craighead); Charter Oak, July (Author). Recorded as breeding in dead aspen (*Populus grandidentata*).

D. punctulata Sch. Breeds in dead pine and occurs throughout the pine sections of the state.

D. pugionata Germ. S. W. Penna. (Dr. Hamilton); Hummelstown, June 12 (Author); Charter Oak, July (Kirk and Knull). Recorded in the literature as breeding in living witch-hazel (*Hamamelis virginiana*), alder (*Alnus*) and *Spiraea opulifolia.*

D. obscura Fab. Breeds in the dead wood of persimmon (*Diospyros virginiana*), and can be found throughout the state where the host-plant occurs It is also recorded as breeding in dead staghorn sumac (*Rhus typhina*).

D. lurida Fab. A common species which has been recorded as breeding in hickory, blue beech (*Carpinus caroliniana*) and alder (*Alnus rugosa*).

D. lepida Lec. S. W. Penna. (Dr. Hamilton); Rockville, June 1 (A. B. Champlain); Hummelstown, July 11 to 29 (Author).

Recorded as breeding in dead ironwood (*Ostrya virginiana*). It was found breeding in the dead wood of hawthorn (*Crataegus coccinea*) at Charter Oak. Recorded by C. W. Stromberg as hibernating around the bases of hawthorn trees.

D. scobina Chev. Found in the fall, on the foliage of sour gum (*Nyssa sylvatica*) in the dead wood of which the insect breeds. The adults hibernate, and can often be found through the winter months.

D. americana Hbst. Pittsburgh (H. G. Klages); Rockville, Dec., under loose bark (A. S. Koser); Delaware Co., July 12 (H. W. Wenzel); Dec. 13, Jan. 9, State College (Author).

D. tenebrosa Kirby. Recorded from New York State, and probably will occur in Penna.

D. tuberculata C. & G. S. W. Penna. (Dr. Hamilton); North East, Sept. 2 (E. M. Craighead); Hummelstown, July 9 (Author); ovipositing in a hemlock (*Tsuga canadensis*) log at Charter Oak, on June 22. Adults emerged from injuries on living hemlocks at Montebello in July and August. The insect breeds in the dry wood around the injuries on living trees.

Poecilonota Esch.

P. cyanipes Say. S. W. Penna. (Dr. Hamilton); North East, Aug. 22 (E. M. Craighead); Milford, June 6 (H. B. Kirk); Charter Oak, July 8 (Author). Recorded as breeding in large-toothed aspen (*Populus grandidentata*).

P. thureura Say*. This species was found breeding in living willow

at Harrisburg by A. B. Champlain and the author.

The egg is laid on the trunk of the living tree, and the larva, working between the inner bark and outer sapwood, does not travel through the infested tree, but remains at the point where the egg was laid. The rapid growth of the tree furnishes sufficient nourishment. Upon reaching maturity a pupal cell is formed between these two layers, which is surrounded by frass, and very much resembles the pupal cell of *Rhagium lineatum*. The life history extends over at least two years, since very small larvae, together with mature larvae, were found in the infested trees during the winter months. Adults were reared from May 26 to May 30.

Cinyra C. & G.

C. gracilipes Melsh. S. W. Penna. (Dr. Hamilton); Harrisburg, June (Kirk and Champlain); Hummelstown, May and June (Author). Recorded as breeding in white oak (*Quercus alba*); swamp white oak (*Quercus bicolor*); and ironwood (*Ostrya virginiana*).

Buprestis Linn.

B. sulcicollis Lec. This species has been recorded from New York State. and probably will occur in Pennsylvania.

B. striata Fab. Found throughout the pine sections of the state. The adults which appear in the spring, having matured the previous fall, pass the winter in their pupal cells. The species breeds in hard and soft pines, although it was found working in a scar on a living hemlock (*Tsuga canadensis*) at Hummelstown, and an adult was reared April 1.

B. striata var. *impedita* Say. This color variety occurs with the preceding.

B. apricans Hbst. Frankford, July 18 (P. Nell); Tidioute (F. L. Holdridge). A southern pine species which probably has been imported in lumber.

B. decora Fab. Philadelphia, May 10 (H. W. Wenzel). A southern species which probably has been brought into the state in lumber.

B. salisburyensis Hbst. S. W. Penna. (Dr. Hamilton); Carlisle Junction, July 4, (A. B. Champlain); Hazleton, July (Dr. Dietz). Recorded in the literature as breeding in pine.

B. lineata Fab. Lehigh Gap, July 3 (G. M. Greene); Inglenook, April 18 (H. B. Kirk); Harrisburg, July 31 (Author). Recorded as breeding in dead pine. A. B. Champlain reared adults from the thick bark of dead pitch pine (*Pinus rigida*) collected at Hunters' Run.

B. maculipennis Gory. Charter Oak, July 9 (Kirk and Champlain); Rockville, July 8 (A. B. Champlain); Mt. Alto, Aug. 4 (Author).

The species usually breeds in dead limbs and branches of pine, although adults were reared July 21, from dead hemlock (*Tsuga canadensis*) collected at Montebello.

B. maculativentris Say. "Penna." (LeConte); Bethlehem (G. W. Caffrey); Milford, July. Recorded in the literature as breeding in pine.

*Determined by W. J. Chamberlain. (Page 80.)

B. nuttali var. *consularis* Gory. Hunters' Run, July 11 (V. A. E. Daecke); Charter Oak, Aug. 12; Harrisburg, Sept. 30; Montebello, Aug. (Author). Recorded as breeding in dead pine.

B. rufipes Oliv. Found throughout the state, and recorded in the literature as breeding in dead American elm (*Ulmus americana*); sour gum (*Nyssa sylvatica*), beech (*Fagus americana*); chestnut (*Castanea dentata*), and hickory. A. B. Champlain found this species breeding in dead oak at Rockville.

B. fasciata Fab. S. W. Penna. (Dr. Hamilton); Endeavor, July 30 (Kirk and Knull); Harrisburg, July 22 (A. B. Champlain). Probably breeds in dead pine.

Xenorhipis Lec.

X. brendeli Lec. Crafton (E. A. and H. G. Klages); Philadelphia. Recorded in the literature as breeding in hickory.

Melanophila Esch.

M. aeneola Melsh. S. W. Penna. (H. G. Klages); Linglestown, June and July (Dr. D. M. Castle); Drumgold, June 1 (Author). Breeds in pine.

M. fulvoguttata Harris. Common throughout the state. It has been recorded in the literature as breeding in red spruce (*Picea rubens*), American larch (*Larix americana*) and hemlock (*Tsuga canadensis*).

M. drummondi Kirby. Recorded from New York State, and probably will occur in the state.

M. acuminata DeGeer. S. W. Penna. (Dr. Hamilton); Philadelphia (H. W. Wenzel). Recorded in the literature as breeding in pine, spruce and fir.

Anthaxia Esch.

A. viridifrons Gory. A common species recorded as breeding in hickory and elm.

A. aenogaster C. and G. Bethlehem (G. W. Caffrey).

A. viridicornis Say. S. W. Penna. (Dr. Hamilton); Harrisburg, May (Author). This species breeds in dead and dying willow in the vicinity of Harrisburg.

A. quercata Fab. S. W. Penna. (Dr. Hamilton); Charter Oak, July 9, Hummelstown, June (Author). Recorded in the literature as breeding in redbud (*Cersis canadensis*), *Crataegus coccinea*, white pine (*Pinus strobus*), grape, American larch (*Larix americana*) and chestnut.

Agrilaxia Kerr.

A. flavimana Gory. Philadelphia Neck, July (H. W. Wenzel); Hummelstown, June 6 (Author). Recorded in the literature as breeding in white oak and plum.

Chrysobothris Esch.

C. sexsignata Say. Common throughout the state and recorded in the literature as breeding in dead hemlock (*Tsuga canadensis*), black ash (*Fraxinus nigra*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), walnut (*Juglans nigra*), hickory, beech, birch, American larch (*Larix americana*), and the outer bark of living butternut (*Juglans cinerea*).

C. scitula Gory. Philadelphia Neck (H. W. Wenzel); Harrisburg, July 4 (Author). Probably breeds in oak.

C. lecontei Leng. Spring Mill, June 21 (F. M. Trimble); Harrisburg, July 4 (J. G. Sanders); Chestnut Hill, June 24 (J. K. Primm); Hummelstown, June and July (Author). Recorded in the literature as breeding in dead alder (*Alnus rugosa*) and swamp white oak (*Quercus bicolor*). Reared from dead sumac by A. B. Champlain and the author.

C. blanchardi Horn. Rockville, July 21 (A. B. Champlain); Endeavor, July 30, Charter Oak (Kirk and Knull). Recorded as breeding in dead pitch pine (*Pinus rigida*) bark. Adults were chopped from the sapwood of dead white pine (*Pinus strobus*) at Charter Oak.

C. pusilla C. & G. A common species which is recorded in the literature as breeding in spruce and pine. Adults were reared from hemlock (*Tsuga canadensis*) collected at Hummelstown.

C. trinervia Kirby. S. W. Penna. (Dr. Hamilton). Recorded in the literature as breeding in pine.

C. verdigripennis Frost. Montebello, July 7 to July 17 (Guyton and Knull). This species works in scars and injuries on living hemlock (*Tsuga canadensis*) trees in the vicinity of Montebello. An adult was observed ovipositing in an injury on July 7. The larvae work beneath the bark of the injured tree, and pupate in the sapwood.

C. dentipes Germ. The bettle breeds in dead pine, and is common throughout the state on pine slash. It has also been recorded in the literature as breeding in American larch (*Larix americana*).

C. floricola Gory. Breeds in dead pine and is common throughout the state.

C. femorata Oliv. One of our most common Buprestids and breeds in a large variety of dead and dying fruit and forest trees.

C. scabripennis C. & G. Rockville, June (Kirk and Champlain); Endeavor, July 30; Charter Oak, June 20 (Kirk and Knull). Breeds in dead white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*).

C. harrisi Hentz. Rockville, June 14 (A. B. Champlain); Charter Oak, June and July (Kirk, Champlain and Knull). Recorded as breeding in dead pine.

Actenodes Lec.

A. acornis Say. Jeannette, July (H. G. Klages); Chestnut Hill, June 24 (J. K. Primm); Charter Oak, July 10 (Champlain and Knull); Hummelstown, June and July (Author). Recorded as breeding in the dead wood of red maple (*Acer rubrum*), black birch (*Betula lenta*), beech (*Fagus americana*), black oak (*Quercus velutina*) and hickory.

Eupristocerus Deyr.

E. cogitans Web. Common throughout the state, and forms galls on the living stems of alder (*Alnus rugosa*) and (*A. incana*).

Agrilus Steph.

A. bilineatus Web. Common throughout the state, and breeds in dead and dying oak and chestnut.

A. bilineatus var. *azureus* n. var. This variety resembles *A. bilineatus* to such an extent that it is deemed necessary to merely give the differences. Elytra bright blue, void of the pubescent vittae on the elytra of *A. bilineatus*. On some specimens there is a faint trace of this strip near the humeral angle, and again near the apical angle of each elytron. Length 8 mm.

Adults of this variety, which may prove to be a distinct species, were collected on the foliage of blue beech (*Carpinus caroliniana*) at Philadelphia in June, by Messrs. F. M. Trimble and J. K. Primm. Later Mr. Primm sent several infested branches of living blue beech to the office of the Bureau of Plant Industry at Harrisburg. Adults emerged from June 1 to June 4.

The author has also reared it from blue beech collected at Hummelstown. The work of this variety was observed in living beech (*Fagus americana*) at Harrisburg by A. B. Champlain and the author, and a dead adult taken from the sapwood. The larvae mine underneath the bark in the living stick, and cause an abnormal swelling around the gallery. The pupal cells are formed in the sapwood.

Type in collection of author.

A. acutipennis Mann. Common throughout the state in June and July on oak foliage.

A. anxius Gory. A common species which has been recorded in the literature as breeding in birch, poplar and willow.

A. pensus Horn. Charter Oak, June 5 (Author).

A. ruficollis Fab. One of our most common *Agrilus* and breeds in the living stems of blackberry and raspberry, forming galls on the stems of infested plants.

A. lateralis Say. Adults of this species were collected on the foliage of sweet fern (*Comptonia peregrina*) at Bear Meadows, Huntingdon Co., on July 5, and a Cedar Run on July 12. The number of adults taken indicated that this plant was the host of the species. An examination showed that *Agrilus* larvae were working in the stems of the living plants.

A. B. Champlain informs me that he had reared a number of adults from the stems of bayberry (*Myrica carolinensis*) at Lyme, Conn. The larvae work in the living stems of the bayberry, causing abnormal swellings. It has been recorded by M. P. Somes as breeding in apple twigs.

A. masculinus Horn. Harrisburg, May 31 to June 3; Charter Oak, June (Author). Adults were reared from the sapwood of dead box elder (*Acer negundo*) and red maple (*Acer rubrum*).

A. pusillus Say. S. W. Penna. (H. G. Klages); Hummelstown, June 12 (Author).

A. frosti Knull. Charter Oak, June 21 (Kirk and Knull); Harrisburg, May 24; Chambersburg, June 6; Hummelstown, June 2 (Author); Berks Co., June 1.

A. defectus Lec. May, June, Hummelstown (Author). Recorded as breeding in white oak (*Quercus alba*).

A. crinicornis Horn. Jeannette (H. G. Klages); Duncannon, June 24 (J. G. Sanders); Charter Oak, June 21; Hummelstown, May and June (Author).

A. egenus Gory. Common throughout the state, and recorded as breeding in locust (*Robinia pseudacacia*).

A. celti Knull. Hummelstown, May and June (Kirk and Knull).

A. cephalicus Lec. York, Reading, Harrisburg, Hummelstown. Reared from sapwood of dead dogwood (*Cornus florida*) (Author).

A. arcuatus Say. Found throughout the state and recorded as breeding in hickory, oak and beech (*Fagus americana*). The larvae prune branches from infested trees.

A. coryli Horn. Found throughout the state where Hazelnut (*Corylus*) occurs. This species has been classed as a variety of *A. arcuatus,* but the work of the two insects differs to such an extent that I have listed it as a distinct species. *A. arcuatus* girdles branches of various forest trees, and *A. coryli* breeds in living hazelnut (*Corylus*) forming galls on the infested stems.

A. B. Champlain informs me that the work of *A. coryli* is common on hazelnut in the vicinity of Lyme, Conn., and that the infested stems are not pruned, but galls are formed due to the circular borings of the larvae. The author has also observed the work in various parts of the state.

A. champlaini Frost. Drumgold (Sanders and Champlain); Charter Oak (A. B. Champlain); York Co., Cedar Run (Author). This species has been recorded as forming galls on living ironwood (*Osirya virginiana*). The larva pupates head down in the center of the gall, and emerges from the lower part of the swelling.

A. imbellis Cr. Recorded from New Jersey, and probably will occur in the state.

A. fallax Say. S. W. Penna. (Dr. Hamilton); New Cumberland (H. B. Kirk); Rockville (Champlain and Knull). Recorded in the literature as breeding in honey locust (*Gleditsia triacanthos*) and hackberry (*Celtis occidentalis*).

A. subcinctus Gory. S. W. Penna. (Dr. Hamilton); Pittsburg, June 19 (H. G. Klages); Hummelstown, June 2 (Author). Probably breeds in poison ivy (*Rhus toxicodendron*).

A. putillus Say. Jeannette, June (H. G. Klages); Hummelstown, June 17; Charter Oak, June 22.

A. otiosus Say. Common throughout the state, and breeds in dead hickory.

A. juglandis Knull. Found throughout the state, and breeds in the outer bark of living butternut (*Juglans cinerea*).

A. sinuatus Oliv. An imported species which has been recorded from New York and New Jersey, and is sure to occur in Pennsylvania.

A. crataegi Frost. Harrisburg, June 7 and June 12 (Champlain and Knull); Charter Oak, June 22 (Author). Recorded in the literature as breeding in *Crataegus.*

A. politus Say. Common throughout the state, and recorded as breeding in striped maple (*Acer pennsylvanicum*) and willow.

A. viridis var. *fagi* Ratz. This is a European species which has been introduced into the state. Adults were reared from June 6 to 11 from living rose (*Rosa rugosa*) stems, collected at West Chester by F. M. Trimble. The

larvae form galls, or abnormal swellings on the infested stems, often killing them. Mr. Trimble found the insect doing damage to nursery stock at Erie and Girard. E. M. Craighead collected adults on wild rose (*Rosa carolina*) in July on Presque Isle. Later Mr. Craighead and the author found numerous rose plants on the island which had been killed.

A. obsoletoguttatus Gory. Common throughout the state, and recorded as breeding in blue beech (*Carpinus caroliniana*), ironwood (*Ostrya virginiana*), red oak (*Quercus rubra*), beech (*Fagus americana*) and hickory. At Harrisburg beech branches were observed which had been pulverized by the larvae of this insect. Also reared from dead birch (*Betula lenta*) collected at Mechanicsburg.

A. vittaticollis Rand. S. W. Penna. (Dr. Hamilton); Endeavor, July 30 (Kirk and Knull); Charter Oak, June 20 (Kirk, Champlain and Knull); Hummelstown (Author). Recorded as breeding in *Crataegus,* shad bush (*Amelanchier canadensis*), apple, pear and wild crab.

A. granulatus Say. S. W. Penna. (Dr. Hamilton); Marysville, June 30 (V. A. E. Daecke). Reared from May 22 to 28 from the sapwood of dead willow collected at Harrisburg by A. B. Champlain and the author. Recorded as breeding in Lombardy poplar (*Populus nigra* var. *italica*) and cottonwood (*Populus deltoides*).

A. lecontei Saund. A common species, and breeds in the dead branches of hackberry (*Celtis occidentalis*).

Rhaeboscelis Chev.

R. tenuis Lec. Angora, June 15 (G. M. Greene); Philadelphia, July; Lester, June 5 (H. W. Wenzel). Recorded as breeding in the swamp rose-mallow (*Hibiscus moscheutos*).

Pachyschelus Sol.

P. purpureus Say. Wawa, May 25 (V. A. E. Daecke).

P. laevigatus Say. Common throughout the state, and recorded as breeding in the leaves of *Lespedeza virginica, Meibomia obtusa* and *M. virdiflora.*

Brachys Sol.

B. tesselatus Fab. S. W. Penna. (Dr. Hamilton).

B. terminans C. & G. Common throughout the state.

B. aeruginosus Gory. S. W. Penna. (Dr. Hamilton); North East, June 9 (D. M. DeLong); Philadelphia, July 14 (H. W. Wenzel); Hummelstown, June 9 (Author).

B. ovatus Web. Common throughout the state.

B. lugubris Lec. Hunters' Run, July 11.

Taphrocerus Sol.

T. gracilis Say. Common throughout the state on grass and vegetation in swampy places.

Mastogenius Sol.

M. subcyaneus Lec. S. W. Penna. (Dr. Hamilton); Philadelphia, June and July (H. W. Wenzel). Recorded in the literature as breeding in dead oak branches.

THE REDISCOVERY OF *ODYNERUS* (*ANCISTROCERUS*) *WALDENII* VIERECK (HYMENOPTERA)

BY E. J. SMITH,
Sherborn, Mass.

In Vol. XVII, Oct., 1906, p. 304 of Entomological News Mr. H. L. Viereck describes a new species of Odynerus under the name of *O. waldonii.* In the next issue, Nov., 1906, p. 350, this spelling is corrected to read *waldenii,* the former spelling being a typographical error.

As I have been for some years interested in the Vespoidea I have got together quite a good series of most of our wasps of that family, and in looking them over I found that I evidently had two species mixed under the name of *albophaleratus,* and in trying to identify them from the keys in Bulletin 22, Conn. Geol. and Nat. Hist. Survey, I found that one was *albophaleratus,* while the other one ran directly to *waldeni* (as spelt there); but as the key stated that only one specimen was known I naturally felt some doubt as to whether my wasps could really be that species.

At that time I was corresponding with Dr. Joseph Bequaert at the American Museum of Natural History at New York and I sent him a specimen and asked his opinion. He replied that although he had several similar specimens in his collection he had never definitely identified them, but would look the matter up and let me know later. Some time afterwards he wrote, "I have now been able to examine the type specimen of *waldenii* Vier. and find it agrees perfectly with the specimen sent by you as being doubtfully that species. The white dot at apex of abdomen is present, though not mentioned in the description."

The species may be briefly described as follows: color, markings and general appearance very similar to *albophaleratus,* but stouter bodied, and in this respect more like *birenimaculatus.* Scutellum with variable spots. On two of my specimens the spots are large and square, and confluent, as is often the case in *birenimaculatus,* and in others the spots are smaller and well separated. Most of the specimens have a small dot on each side of postscutellum, one has a continuous band, and in two instances the postscutellum is wholly black. But the most conspicuous mark of distinction between this species and *albophaleratus* is a white blotch on dorsum of last abdominal segment. This I have never found in *albophaleratus,* but is present in the ♀ of *birenimaculatus.* One specimen has a white dot on each side of second segment. The clypeus is very variable, in some specimens it is largely white, while in others the black predominates. One specimen, which was dug out of a decaying stump by Mr. C. A. Frost while searching for coleoptera on May 15th, 1921, differs from the rest in having only the merest trace of spots on each side of scutellum, and none on the postscutellum. My specimens are all females, and dated as follows: June 17, 1917, June 5, 8, 15, 1918, Aug. 7, 15, 1919. Locality, Sherborn, Mass. One sp. Framingham, Mass. V. 15, 21, C. A. Frost. The date of the one sent to Dr. Bequaert was not noted. Eight specimens in all. Most of mine were taken on flowers of syringa. There are also several other specimens in the collections of Mr. A. P. Morse, of Wellesley, and in the Boston Society of Natural History. From the wide difference in dates of capture it would seem that this species (like most of the Odynerri) is double brooded. I have no authentic male.

THREE NEW SPECIES OF PARASYNTORMON WITH A TABLE OF SPECIES. (DOLICHOPODIDAE, DIPTERA).

BY M. C. VANDUZEE,

Buffalo, N. Y.

TABLE OF MALES.

1. Arista apical or nearly so .....2.
   Arista distinctly dorsal, although sometimes placed at apical fourth of third antennal joint .....7.
2. Third antennal joint about twice as long as the height of the head. (Mexico) .....*wheeleri* Aldrich.
   Third antennal joint about as long as the height of the head, or shorter ....3.
3. First antennal joint more or less yellowish white below (California) .....*lagotis* Wheeler.
   Antennæ wholly black .....4.
4. Arista distinctly subapical, fully half as long as third antennal joint, (Wyoming) .....*hinnulus* Wheeler.
   Arista wholly apical, about one fifth as long as the third joint .....5.
5. Third antennal joint nearly evenly rounded below, (California; Colorado) .....*asellus* Wheeler.
   Third antennal joint but little narrowed before its middle, where there is a small offset below, from which point it rapidly tapers to a point .....6.
6. Fore coxæ and femora largely blackish (California) .*fraterculus* new species.
   Fore coxæ and femora pale yellow, (California) .....*mulinum* new species.
7. Arista inserted near apical fourth of third antennal joint .....8.
   Arista inserted at or before the middle of the third antennal joint .....9.
8. Third antennal joint with a small offset at insertion of arista both above and below, (California) .....*emarginatum* Wheeler.
   Third antennal joint evenly rounded below, not notched above, (California) ..... *lepus* VanDuzee.
9. Arista twice as long as the third antennal joint, which is subquadrate, (Wyoming; Utah; Nevada) ..... *occidentale* Aldrich.
   Arista not or but little longer than the antenna .....10.
10. Third antennal joint large, obliquely truncate at tip, (Wyoming; California) .....*montivagum* Wheeler.
    Third antennal joint gradually tapering from near its base to an acute point, (California) .....*flavicoxa* new species.

Parasyntormon fraterculus n. sp.

Male: Length 2 mm. Face narrow, brown with a little white pollen at lower edge. Palpi brown. Proboscis yellowish brown. Front a little green. Antennæ black; third joint about as long as the height of the head, basal half of nearly equal width, at the middle of lower edge there is a slight offset, from which point it tapers rapidly to a point; arista apical, about one fifth as long as the third antennal joint; second joint lapping over the third about one fifth of the length of the latter.

Thorax and scutellum bronze green, dulled with gray pollen. Abdomen more coppery, without yellow even on the venter. Hypopygium shining black

with a few short stiff bristles; outer lamellæ narrow, brownish, fringed with long black hairs; inner appendages even more conspicuous, consisting of a pair of black halter-like organs with the knob somewhat obcordate.

All coxæ black with their tips narrowly yellowish; fore and middle femora blackish on basal half or more; posterior pair blackish above, yellowish on lower half. The anterior ones have the usual row of rather long delicate black hairs below. Fore and middle tibiæ and basitarsi dark yellow; posterior tibiæ and tarsi almost wholly infuscated. Fore tarsi black from the tip of first joint; first joint with the usual three bristles below on basal half; second joint swollen as in all the species of the genus. Middle tarsi almost wholly infuscated. Hind tarsi with the second and third joints of nearly equal length, first shorter. Calypters and halteres yellow, the cilia of the former black, at least in most lights.

Wings uniformly tinged with brown; fourth vein parallel with third, ending in the apex of the wing; last section of fifth vein fully three times as long as the cross-vein; anal angle prominent.

Described from one male which I took at Watts, Los Angles Co., Calif., April 1, 1915. Type in the authors collection.

Parasyntormon mulinum n. sp.

Male: This agrees with *fraterculus* in size, the color of head and thorax and in the form of the antennæ.

The abdomen is bronze green, the venter and sides of the second and third segments yellow. Hypopygium small, black with a few short blunt bristles; the outer lamellæ are yellowish brown, rather narrow, fringed all around with black hairs; I cannot see any inner appendages.

Fore coxæ yellow, middle and hind ones mostly black, their tips yellow. Femora and tibiæ yellow, tips of the posterior femora brownish. Fore tarsi black from the tip of the first joint, which has four bristles on the lower edge of basal half; second joint incrassated as usual in this genus. Middle and hind tarsi mostly brownish black, the latter with the first and third joints about equal in length, second joint longer. Calypters yellow with black tips and cilia. Halteres yellow. Wings about as in *fraterculus*.

Described from one male which I took at Carrizo Creek, San Diego Co., California, April 17, 1915. Type in the author's collection.

Parasyntormon flavicoxa n. sp.

Male: Length 3 mm. Face white, very narrow, the eyes almost touching below. Front blackish. Palpi white, small. Proboscis yellow. Antennæ black; third joint about as long as the face, which is also long, they taper to an acute point and are slightly notched where the arista is inserted at about its basal third. Arista a little longer than the antennæ.

Thorax green, dulled with brownish gray pollen. Abdomen dark green, the venter on second to fourth segments yellow, this color extends on to the dorsum on the second and third segments; the hairs of the abdomen are yellowish. Hypopygium rather large for the genus, blackish; its lamellæ small, narrow, fringed with hairs on the edges; the inner appendages are a pair of rather long yellow organs, which are enlarged at tip where there are several stiff hairs, on the side of their stem is a short blunt branch with two hairs at tip.

All coxæ, femora, tibiæ and basitarsi pale yellow; tips of hind femora brown above; the usual row of bristles on the lower edge of fore femora are yellow, still they appear brown or black in certain lights. Fore basitarsus with four bristles below on basal half; second joint enlarged as usual in this genus. Middle tibiæ with row of delicate black hairs on apical half of lower surface. which are as long as the diameter of the tibia. Middle tarsi infuscated from the base of second joint, hind ones almost to the base of first joint; first and third joints of hind tarsi of equal length, second joint longer. Calypters pale yellow with black tips, their cilia yellow, appearing brown in certain lights.

Wings dark grayish; they seem to be formed about as usual in the genus but are folded so as to make it difficult to see details.

Described from one male, which I took at Berkeley, California, May 23, 1915. Type in the author's collection.

MICROLEPIDOPTERA : NOTES AND NEW SPECIES.

BY ANNETTE F. BRAUN,

Cincinnati, Ohio.

Marmara fraxinicola n. sp.

Maxillary palpi white inwardly, black outwardly; labial palpi white, outer side of second segment and a spot near tip of third segment black. Antennae white, pecten black. Head, thorax and fore wings shining white. At extreme base of costa, a small brown spot, outwardly margined with dark brown scales; immediately following it, and connected with it by minute brown dusting is a large spot reaching to the fold, with a few scattered brown scales below the fold, dark margined outwardly and on the costa inwardly. Just before middle of wing a brown fascia, angulated on the fold, and narrowing beneath it, sometimes only the dark brown margin reaching the dorsum. At two-thirds an oblique fascia, forked below costa, the inner fork indistinct and continued in a line to the dorsum, the outer fork convex and curving to dorsum at tornus; between here and the apex, an oblique slightly curved fascia. A minute brown apical spot, lying in the angle between, two oblique brown lines running into the white cilia on either side of the apex; a brown line through base of apical cilia between these two oblique lines. Hind wings and cilia dark brown, concolorous with dark brown margins of the fasciae. Legs white, anterior and middle femora brown, hind legs with oblique brown streaks. Expanse : 8.5 mm.

Type (♀) in the writer's collection; Cincinnati, Ohio, May 13.

The larva is a miner in twigs of white ash (*Fraxinus americana*). The larva begins its work in the new growth, and finishes mining in March and April of the following year. The mine is extremely long and is rarely found except on saplings or in rapidly growing shoots. Pupation takes place about the last of April, in an elevated fold of the bark at the end of the mine.

This species is distinguished from its nearest allies (*fulgidella* Clem. and *elotella* Busck) by the dark brown lustreless hind wings, and by details of the wing markings.

Marmara auratella Braun.

Braun, Can. Ent., XLVII, 193, 1915.

The two specimens from which this species was originally described were reared from mines on the cultivated variety of *Rudbeckia laciniata,* and careful search since has failed to disclose any more mines on this plant; however a number of specimens have been reared from year to year from mines on the stalks of Dahlias in cultivation. If *Dahlia* is the original food plant, as seems probable, the species is of Mexican origin, and its survival in northern latitudes due to the habit of a large proportion of the larvae of pupating very near to the base of the stem. When several inches of stem are stored with the roots, these pupae are preserved. Pupae in stems cut off and left out-of-doors during the winter do not survive.

Parectopa occulta n. sp.

Maxillary palpi white inwardly, black outwardly; labial palpi white, outer side of second segment towards apex and extreme tip of third segment blackish. Antennae black, anterior edge for about half the length white. Head and middle of thorax white. Sides of thorax and fore wings dark brown; a faint golden tinge in apical third of wings. Five white costal streaks and a broad white stripe along the dorsal margin from base to tornus. Upper edge of dorsal stripe just below fold somewhat undulating and beyond its middle sending a short pointed oblique projection to the fold; at the end of the white stripe a similar slightly longer projection nearly meets the end of the very oblique narrow white first costal streak starting at the basal fourth. The second costal streak just beyond the long oblique streak is very short and scarcely defined, sometimes almost obliterated; the third, oblique, reaches to the middle of the wing; the fourth, less oblique, passes entirely across the wing to the termen, and is white on the margins, silvery in the middle; the fifth partially encloses the apex, in which there is a velvety brown spot; a dark brown line in apical cilia and a brown ciliary hook. Beyond the end of the dorsal white stripe a small triangular white spot, and between it and the end of the long oblique first costal a short obliquely placed silvery bar. Hind wings and cilia dark fuscous. Legs white, obliquely barred with dark brown. Underside of body silvery. Expanse : 9 mm.

Type (♂), *Paratype* (♂), in the writer's collection; Powell County, Kentucky; imagines July 12.

The larvae collected June 26, mine leaves of vetch (*Vicia caroliniana*) forming irregular somewhat digitate greenish mines starting over the midrib, where the mine is whitish. Cocoon papery, in a fold of the leaf.

Closely allied to *P. salicifoliella* Clemens and *P. thermopsella* Chambers; it differs from the former by the longer more distinct white costal streaks, and shorter more indented white dorsal stripe; from the latter chiefly by the different lengths of the costal streaks and the nearly obsolete second costal streak.

Gracilaria murtfeldtella Busck.

Busck, Proc. U. S. N. M., XXVII, 771, 1904; Ely, Proc. Ent. Soc. Wash., XIX, 76, 1917.

The gall-producing habit of this species is unique in the genus *Gracilaria;* accompanying this feature are also some peculiarities in larval structure, cocoon

and imaginal habits. In imaginal structure, however, the species does not differ from other members of its genus.

The oval elongate stem gall, which resembles that of *Gnorimoschema gallaesolidaginis,* but is somewhat more elongate, is found on the stem of *Pentstemon laevigatus,* rarely on *Pentstemon hirsutus,* and, judging from the wide distribution of the moth, on other species of *Pentstemon* elsewhere. It may be situated at the extreme base of the stem, just above the surface of the ground, or several inches up the stem; in the latter case, the gall is more symmetrical. The presence of the gall in some way aborts the development of the shoot, as no instance was observed in which gall-bearing stems produced blossoms, although these stems were ones which normally would have bloomed. An examination of stems bearing galls showed indications of a mine running down from the tip of the shoot through the center of the stem; this would seem to indicate that the egg is deposited, presumably in the autumn or early spring, in the center of the rosette and that the larva upon beginning to mine destroys the growing tip of the shoot. The gall has reached its full size in June, although the larva continues to feed during the greater part of the summer, pupation taking place about September 1 in the vicinity of Cincinnati.

The larva has three pair of thoracic legs well developed, but prolegs, except those of the last abdominal segment, are entirely lacking. On each abdominal segment except the last three, there is a pair of dorsal tubercles; faint indications of these are present on the thoracic segments.

At the time of pupation, the larva eats almost through the wall of the gall, leaving merely a semi-transparent circular window of whitish epidermis through which the pupa is thrust at emergence. The cocoon is of thin papery silk, attached to the wall of the gall below the exit hole. At its upper end it bends rather abruptly continuing as a tube leading to the opening. In cross-section, the cocoon is cylindrical, The imagines emerged from September 5 to 25.

The resting position of the imago is that characteristic of the genus; the antennae are folded backward along the middle of the wing. When disturbed, the moth does not twirl the antennae, as is usual in species of *Gracilaria,* but moves them up and down with a scarcely noticeable rotary motion—much as a long-horned locust; after a few such movements, it folds the antennae back along the middle of the wing.

Most of the reared specimens have a greater amount of the deep orange brown color than is indicated by the original description. This color forms longitudinal streaking, often leaving the yellow ground color below the fold only; the cilia below apex are orange brown.

About 80% of the larvae found in any given area are parasitized. In addition, the galls, especially the parasitized ones, are inhabited by the larvae of Hymenoptera (a saw fly in one instance) which were found at the ends of the gall and in the unswollen stem beyond; dipterous larvae are also found, embedded in the tissue of the outer walls of the gall.

Elachista radiantella n. sp.

Palpi silvery gray, dark brown outwardly; antennae dark brown, shading to silvery at tip in the female; face silvery gray, head above brown, with a faint

reddish luster. Thorax brown, with a more pronounced purplish red tinge; tip of mesothorax and a few scales at tips of patagia silvery. Fore wings deep shining golden brown, with pearly iridescent markings; an oblique fascia crossing almost at base of wing; a distinctly angulated fascia near middle of wing; at tornus a silvery spot, and beyond it on costa almost at apex of wing, a larger curved streak which extends nearly to termen below apex, and is somewhat dilated below costa. Tips of scales around apex very slightly darker than the ground color; cilia brown. Hind wings and cilia gray, with a faint reddish coppery luster, darker in the male. Legs dark brown, femora silvery gray; tips of segments and a broad band around middle of hind tibiae silvery. Expanse : 5.5 mm.

Type (♀), U. S. National Museum; one *Paratype* (♂), U. S. N. M.; one *Paratype* (♀) in the writer's collection; all reared on *Panicum* at Washington, D.C. by Mr. August Busck. Mine "transparent, white, irregularly elongate;" pupa "hanging head downward, attached at the anal end only;" no cocoon. Larvae collected July 8 and 9; pupae July 10; imagines emerged July 18 to 20.

The pupa is in general of the ovate, shining type, but with the lateral ridges more prominent than usual; the median ridge does not extend on to the thorax. A raised ridge along each side of dorsum of mesothorax, followed posteriorly by two pairs of tubercles, tubercles of the second pair small and close together at tip of mesothorax; a group of five irregularly shaped tubercles laterally; a short divided hood projecting over face; prominent tubercles on front of head. (Above description made from pupal skin).

Of the described species it resembles in markings most nearly the species described below; but is distinguished from it by the venation and details of markings. Vein 4 of the fore wing is absent; vein 4 of the hind wing absent.

Elachista solitaria n. sp.

Palpi silvery gray, blackish outwardly; antennae dark brown, thickened with scales; face dark silvery gray, shading to dark brown on the head posteriorly. Thorax silvery gray, except anterior border, which is dark brown. Fore wings very dark brown; a small silvery gray spot at base of costa not reaching below fold; a brilliant silvery slightly curved fascia just beyond one-third; at tornus, a narrow erect triangular spot; beyond it, almost at apex, a curved costal streak, dilated in the middle of the wing and extending almost to the tip. Cilia white opposite apex, dark brown elsewhere. Hind wings and cilia dark brown. Legs dark brown, femora, tips of segments and a band around middle of hind tibiae silvery. Expanse : 5 mm.

Type (♂), in the writer's collection; reared from a mine on *Panicum* sp., Powell County, Kentucky. Mine collected June 26; imago July 10.

The mine begins as a narrow thread running along the margin of the leaf to the tip, then turning and abruptly enlarging into a blotch, 30 mm. long and 8 mm. broad at its lower end. Pupa enclosed in a very thin, whitish, almost invisible cocoon.

The pupa resembles that of the preceding species, with which it agrees in general form and arrangement of tubercles and ridges, but from which it differs

chiefly in the following respects: lateral ridges of abdomen more prominent, lateral tubercles of mesothorax larger and more conspicuously projecting when the pupa is viewed from the dorsal side.

In venation, this species agrees with the figure given in Meyrick's Handbook.

This species and *E. radiantella* differ from the other silver-marked species by the more posterior position of the costal streak before apex, it being farther from the fascia than the fascia is from the base of the wing. From *E. radiantella* this species is at once distinguished by the difference in venation; the thickened antennae, color of thorax, absence of basal fascia and white cilia also characterize it.

Elachista praematurella Clemens.

Clemens, Proc. Acad. Nat. Sci. Phila., 172, 1860.
Syn. *cristatella* Chambers, Can. Ent., viii, 72, 1876; *albipalpella* Chambers, Jn. Cinn. Soc. Nat. Hist., iii, 294, 1880.

A large series of reared and captured specimens establishes the synonomy as given above. The form described as *praematurella* by Clemens is the usual one occurring throughout the year. The form *albapalpella* is found commonly in early spring, but occurs also rarely in later generations; in it the ground color of the basal half of the wing is grayish, the outer half nearly black, and the white fascia and spots are distinct. In the form *cristatella*, the fascia is very narrow, sometimes almost obsolete, and the ground color much paler, speckled black and white; the black patch of raised scales, exterior to the fascia near the dorsal margin, is most conspicuous in this form, while nearly concolorous with the wing in other varieties.

The larvae mine in a variety of grasses, among them Kentucky blue grass (*Poa pratensis*), *Hystrix, Elymus,* and *Agrostis;* pupa enclosed in an open meshwork cocoon. The lateral ridges of the abdomen in the pupa bear a series of sharp spine-like projections.

NEW AND LITTLE KNOWN CANADIAN SYRPHIDAE (DIPTERA)

BY C. HOWARD CURRAN,
Orillia, Ontario.

Asemosyrphus canadensis n. sp.

Face produced downwards and slightly forwards into a long cone; whole fly black, mostly shining; ocelli very widely separated.

Length 9 to 10 mm. *Male.* Face and front shining black, the sides of the face obscured by whitish yellow pollen, leaving a median stripe and the cheeks shining; front broadly covered with similar pollen on the lower half, except an arch above the antennae. Lower half of the face produced as in *Helophilus conostomus* Will., but produced only a little forward, with a long, slender, not prominent tubercle below the middle, above which it is shallowly concave, and below which it is almost straight to the tip of the oral margin; antennal prominence narrowly reddish above the antennae. Antennae shining black, tip of second joint and immediate base of third somewhat reddish; third joint opaque, whitish pubescent, subquadrate, slightly broader than long and slightly shorter than the second joint, but longer than the first; arista

bare, long, slender, tapering. Posterior orbits yellowish gray pollinose. Pile: on the face limited to the sides, fine and whitish, cheeks bare; front with pale yellow pile, but with a black band across the anterior ocellus; posterior orbits with whitish pile below and yellowish above. Dorsum of thorax shining blackish green; a moderately wide opaque black median stripe not quite reaching the scutellum and which usually has a very slender shining stripe in its middle; on each side of this a shining stripe, obsolete before the posterior quarter, wider than the median opaque stripe; on the outer side of this is a broad, opaque black stripe, which is expanded on the posterior quarter to join the median opaque stripe, is partly interrupted at the suture, and encloses a more or less distinct narrow shining stripe; near the sides is a very narrow opaque stripe on the posterior two-thirds, interrupted at the suture. The shining stripes appear to have a grayish tint in some lights. Pleura and scutellum shining blackish green, with pile of a paler yellowish color than that on the dorsum. Abdomen shining greenish black with a metallic reflection in some lights, the first segment slightly grayish; second segment with a large basal opaque black triangle, broadly separated from the lateral margin and apex; third segment with a small opaque roundish or oval spot before its middle, sometimes obsolete; abdomen elsewhere shining; no lighter markings. Pile of the abdomen pale yellowish, but across the disc on the posterior half of each segment with shorter black pile. Legs shining greenish black, tips of all the femora and narrow bases of tibiae reddish (in one specimen the bases of the tibiae are more broadly yellowish and there is also a yellowish band just before the middle); hind femora considerably enlarged, the greatest swelling near the middle; hind tibiae arcuate, not ending in a spur; all the tarsi golden pubescent beneath. Wings a little infuscated; veins reddish, but brownish apically, basal portion of 2–3 longitudinal vein with about seven bristles of a blackish or reddish brown color. Squamae pure whitish with white pile; halteres brownish yellow.

Holotype, ♂, Raddison, Sask., July 29, 1907, (Jas. Fletcher), in the Canadian National Collection, Ottawa.

Paratypes, 1 ♂, same data, 1 ♂, Kinistino, Sask., July 25, 1907, (T. N. Willing).

This species is very distinct from the only other species in the genus reported from Canada, *A. mexicanus* Macq., and is readily recognized by the absence of light abdominal markings and the conically produced face.

Helophilus bilinearis Will.

Occurred in company with the above but was more abundant on April 28th, becoming scarce a week later. It is apparently a slightly earlier species. About 30 specimens were taken, including five females.

It varies considerably. Specimens occur with only yellow triangles on the second segment, while others have, in addition, partial lunules on the third segment and the entire lateral margin yellow. The female very closely resembles *H. lunulatus* but may be distinguished as follows: The lunules on the third and fourth segments are more grayish and seldom even touch the lateral margins; the face is slightly shorter and less rounded on the lower half. The anterior legs are usually darker than in *lunulatus*.

Syrphus grossulariae melanis, n. var.

Female. Length, 12 to 13 mm. Similar to typical *S. grossulariae* but the abdominal bands are metallic greenish or greyish black, sometimes with an obscure reddish metallic reflection in certain lights (old specimens). The metallic bands are covered with pallid pile, almost whitish, and the femora are a little more extensively black at the bases.

Holotype, ♀, Orillia, Ont., Sept. 18, 1921, (C. H. Curran), in the Canadian National Collection.

Paratypes, 4 ♀s, Orillia, Ont., Sept. 17, 18, 19, 1921, and Orillia, no date. There is an additional specimen in the Canadian National Collection.

This variety shows a peculiarity I have not noticed in the typical species, in that it keeps its wings in motion, as do some species of *Villa* (Bombyliidae) while visiting flowers, and is easily mistaken for a species of that genus. Both the typical form and the variety seem to be equally common on Wild Aster in the vicinity of woods about Orillia. All the specimens taken this year were females.

OCCURRENCE OF *AGRILUS CŒRULEUS* ROSSI IN AMERICA

BY C. A. FROST,

Framingham, Mass.

Two specimens which do not seem to differ from my European material of this species have been sent me by Mr. L. G. Gentner of the Michigan Agricultural College. They were taken by Mr. Charles L. Fluke at Sturgeon Bay, Wisconsin, July 26, 1920. He reported them very abundant flying about over wild raspberry bushes.

On May 28, 1921, while sweeping weeds and grass in a most unpromising pasture in Sherborn, Mass., I was much surprised to find a specimen of this same beetle in my net. The occurrence in such widely separated localities is interesting and it is probable that other captures of this species have been made elsewhere without its recognition.

It might be mistaken for a bluish-green specimen of *politus* or the closely allied *burkei* Fisher, but an examination would disclose the median concavity of the head with the deepest part just above the clypeus, the sharp and deep emargination of the prosternal lobe which is limited at each side by an acute angulation, and that indefinable sculpture above, characteristic of several European species.

The identification is based on comparison with specimens labelled "Carniolia" and "Austr. inf.," "det. v. Krekich," which were received from Europe some years ago.

Marseul in his Monograph of the Buprestidae gives the habitat as France, Germany, Spain, Portugal and Italy, being nowhere rare. He states that it lives particularly on the oak and beech, but also on the birch and alder.

CORRECTION

On page 70, line 29, read *Chilosia ontario* for *chilosia rita*.

Mailed July 10th, 1922.